ABSTRACT

An adaptive multi-tap frequency domain digital filter processes an input signal vector X from a plurality of spatially separated transducers that detect energy from a plurality of sources including a target energy source and at least one non-target energy source. The filter receives and processes the input signal vector X to attenuate noise from non-target sources and provides an output signal vector Y. Tap weights W_N for filter are selected by first parameterizing each of the tap weights W_N such that each of the tap weights W_N is characterized by a vector of parameters $\underline{\beta}_{opt}$, and the solving for each parameter of the vector $\underline{\beta}_{opt}$ by minimizing the expected power of the array output signal Y. A robustness-control transformation is then applied to the vector $\underline{\beta}_{opt}$ to provide a robust vector $\underline{\beta}_{rob}$, wherein the robustness-control transformation identifies and reduces target canceling components of the vector $\underline{\beta}_{opt}$ while preserving non-target canceling components. Finally, the weight vector indicative of the filter tap weights is formed as a function of the vector $\underline{\beta}_{rob}$. Notably, the present invention separates the robustness constraining process from the beamforming power minimization, in contrast to prior art techniques which combine the robustness constraint into the beamforming power minimization. The present invention uses a direct and flexible robustness control mechanism to yield a beamformer that provides good performance and is robust to a wide variety of adverse conditions.